(54) Title: PANEL DISPLAY OF CHANNEL AND SYSTEM STATUS INFORMATION FOR MULTICHANNEL COMMUNICATIONS DEVICE
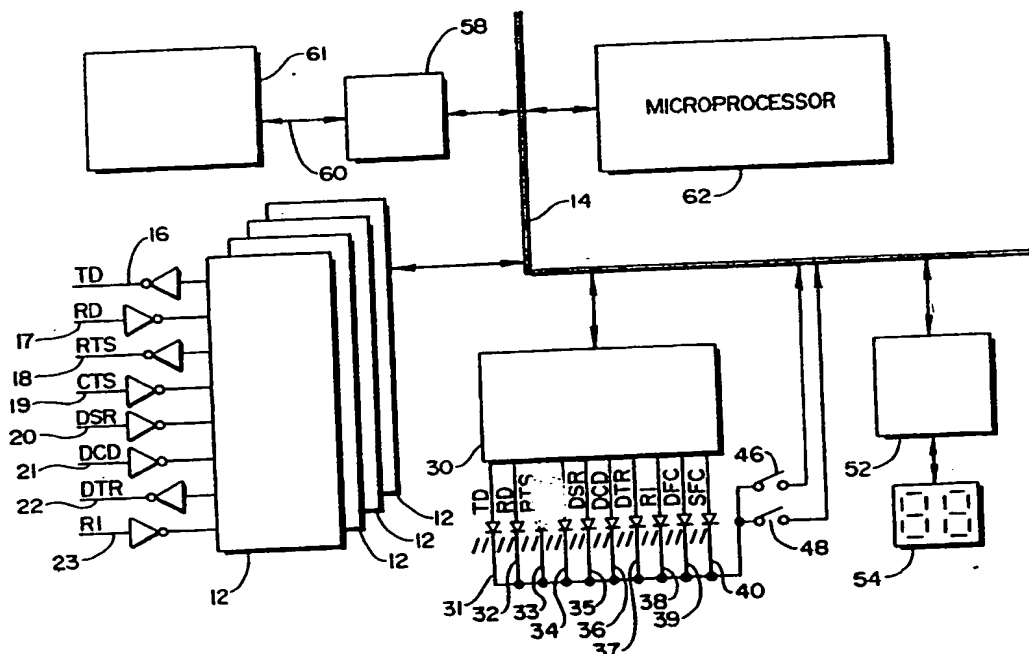
(57) Abstract

A diagnostic display for a multi-channel asynchronous serial ports (12) peripheral which provides an indication on a common array of indicators (31-40) of the status of each signal and modem line and input and output flow control and is switchable between ports.

PANEL DISPLAY OF CHANNEL AND SYSTEM STATUS
INFORMATION FOR MULTICHANNEL COMMUNICATIONS DEVICE
Background of the Invention

For years breakout boxes have been used to
05   diagnose problems and monitor the activity of RS-232
lines. Such breakout boxes may include red and green
LEDs flickering in response to direct connection to
transmit, receive and modem control signals. Such
breakout boxes conventionally have a single indicator
10   for each function and there is no provision for using
a particular LED for display of multiple or selected
functions. Use of a permanently installed breakout
box as a display device would be cumbersome in
devices where as many as eight ports are to be
15   continuously monitored.

It is also well known in the art to use
asynchronous serial ports boards to communicate with
modems, printers, terminals and other computers.

The present invention combines the
20   diagnostic and monitoring functions with multiple
channel communications board functions in a single
box that can perform both roles. It also adds some
diagnostic features not present in the prior art.

There have been other inventions that

combine a breakout box with another function. For example, most medium to high priced modems come standard with several LEDs arranged on the case of the unit to indicate transmit, receive, Terminal

05   ready, Carrier detect and other functions such as communication speed.

It is also known in the prior art to provide a modem rack containing 1 to 10 card-pluggable modems, with a front panel display switchable to any

10   of the 10 modems, with the single display showing the status of the same signals commonly handled on individual modems.

There have even been some previous asynchronous terminal port products that have

15   displayed some status indication for each channel as well. One product showed transmit and receive data simultaneously for each of 1 to 8 terminals, on 16 front-mounted LEDs.

None of the prior products have displayed

20   the information on ports and communications lines and on the system in the unique manner of the present invention as described below.

Brief Description of the Drawings

Fig. 1 is a block diagram of the multiple

25   port communications processor according to the present invention.

Detailed Description of the Drawings

The display functions in accordance with the present invention combine in a unique manner the

30   provision on individual channel operation and system operation and selectively display it on a single array of LEDs and a numeric display showing the function or channel selected. The display functions include:

       *   A "select one of several ports", breakout box monitor feature.

       *   A numeric indication of the currently displayed port.

05   *   An algorithm to flicker the transmit/receive indicating LEDs to make the displays appear to be indicating transmission and receipt of data.

       *   Diagnostic signals indicative of IFC and OFC

10   status.

       *   Integration and display of the above-mentioned features together with the other status displays AC, PC, PU, LU, and EC etc. on the same array of indicators on the

15   same physical display hardware.

Referring now to Fig. 1, the components that cooperate as a part of the present invention are shown. A typical peripheral device 10 embodying the present invention is a data concentrator having

20   multiple UARTs 12 communicating with a data bus 14. Each UART has terminals 16 through 23 either communicating or receiving control signals relating to the operation of that UART. Data on the status of the control signals on terminals 16 through 23 is

25   available on data bus 14 and accessed by the LED latch circuitry 30 which in turn drives, in the preferred embodiment shown, ten LEDs 31 through 40 which are mounted so that their light output is visible on the outside of the case of the data

30   concentrator 10.

A pair of mode selector switches 46 and 48 are used to step the latch circuitry 30 and 52 through a sequence of modes to display the indications for each of the UARTs 12 and through the

system functions of the entire device as discussed in further detail below. A set of display latches 52 also receives information from bus 14 which enables it to display characters on a character indicator

05 which, in the preferred embodiment disclosed comprises a pair of seven segment LED displays 54 which indicate which port is having its individual indications displayed or which systems operating functions are being displayed.

10 The concentrator according to the present invention, as shown in its preferred embodiment in FIG. 1 is unique in a number of important ways from prior art breakout and monitor arrangements.

The operator can choose which of the

15 functions to display with two left/right auto-repeat buttons 46 and 48 on the front panel to cycle the LED latch 30 and display latch 52 through the sequence of available functions. The identification of the particular display or monitor function chosen is

20 indicated on display 54 and the status is displayed on LEDs 31 through 38.

The display selections available for the entire device or concentrator 10 are:

AC – Activity

25 PC – Packet Count

PU – Processor Utilization

LU – Line Utilization

EC – Error Count

30 01 – Port 1 status

02 – Port 2 status

● ● ●

16 – Port 16 status

When the AC mode is selected to provide a
visual display of the activity of the operation of
the system in which the peripheral device or
concentrator is a part, the AC display function in
05   the software for the panel generates signals to
sequentially illuminate adjacent LEDs in the array of
LEDs 31 through 40 at a precession rate of about one
position each 1/2 second. For each active (transmit
or receive) port, that precession speed is increased
10   by one position each 1/2 second, so that when the
system or concentrator is idle the display updates
regularly, but when it becomes busy, the precession
of the light display across the diode array appears
to be quite rapid.

15   Note that the PC, EC, PU and LU displays
below refer to the status of a serial line 60
connecting the host computer 61 through a serial
controller card 58 to bus 14 in concentrator 10.
This serial line can operate at various speeds and in
20   various modes over modems, 4-wire links and 8-wire
links. A host computer interface card which operates
in accordance with the preferred embodiment of the
present invention supports two such communication
lines, each of which may "daisy-chain" connect to up
25   to 8 concentrator boxes.

The PC and EC display functions use the 10
status LEDs 31 through 40 as a binary counter, where
all lights OFF are zero, the right most LED ON is
one, and so on. The PC function displays the lower
30   ten bits of the count of all the packets received
since startup. The EC function shows a one minute
time-weighted average of the number of errors
recently encountered. As a result PC updates quickly
as packets are received and transmitted (can be 300

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packets per second) while EC tends to remain dark
unless there are data communication errors.

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The PU and LU functions are respectively
representative of the 0-100% utilization bar graphs
of the processor and of line utilization. Processor
utilization is scaled to be zero when the
concentrator 10 is idle, and 100% when it is
beginning to fall behind on its duties. Likewise
Line Utilization is scaled to be zero when
communication line 60 is idle. An indication of 100%
means that the line is operating at approximately
100% of its theoretical maximum throughput.

When the information relating to the
operation of an individual port is selected, the
following indications for that port are displayed on
LEDs 31 through 40 respectively:

TxD - Transmit data
RxD - Receive data

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RTS - Request to send
CTS - Clear to send
DSR - Data set ready
DCD - Data Carrier Detect
DTR - Data terminal ready
RI - Ring Indicator

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All of these signals reflecting the status
of an individual port are software controlled,
mimicking the signals one would see on a regular
breakout box which directly reads the signals
present at their respective terminals. In the
implementation illustrated as a part of the preferred
embodiment disclosed, the checking of the signal is

periodically sampled and the display is updated about
50 times per second.

In the case of transmit and receive data,
users accustomed to hard wired breakout boxes are
05   accustomed to seeing hardware LED indications flash
as data is sent. In the preferred embodiment of the
present invention, the software mimics this operation
using a random number generator to flash the LEDs
with about a 70% ON duty cycle. The visual effect is
10   reassuringly close to the familiar pattern. One
difference is that since the display according to the
present invention is updated every 1/50th second, a
single character at a high baud rate results in at
least a 1/50th second flash. This is far more
15   visible than one flash for less than 1/4000 second
which would be used in prior art breakout box
monitors to indicate most characters at a data rate
38400 baud.

The next six display signals RTS, CTS, DSR,
20   DCD, DTR and RI all turn ON steady when active, as do
their counterparts on hardware devices.

In addition to the above functions, the
monitor detects and displays two additional
diagnostic criteria which are as follows:
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OFC - Output Flow Control Active
IFC - Input Flow Control Active.

Output Flow Control is active when a flow
30   control stop character has been received from a
remote device or when a remote device is signalling
that it is not ready to receive data by dropping at
least one of a user configured set of modem control
lines. When output flow control is active, the port

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is inhibited from sending data, and then the OFC LED
39 comes ON to indicate this fact. Prior art
monitoring and display systems have not provided a
display of this signal. Noting the presence of this
05 condition and determining the reason for it is a
common task of a computer system administrator.

Input Flow Control is active when the local
device is no longer ready to receive data because its
input buffer is full, and no internal program has yet
10 read in the data. This condition may be signaled by
sending a flow control stop character or by dropping
a set of modem control signals. No display of this
function was provided by prior monitoring and display
devices. In any case, the IFC LED 40 comes ON to
15 indicate to the system administrator the existence of
the condition.

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What Is Claimed Is:

1.   In a multi-channel communication device, an integrated display means for showing the status of each channel individually, comprising, in combination:

        (a)   indicator means having a plurality of ON-OFF indicating elements;

        (b)   monitor means operatively coupled to monitor the status of each of the channels;

        (c)   selector means coupled to the monitor means for selecting an individual channel to be monitored and providing status information relating that channel to the indicator means; and

        (d)   character indicator means coupled to the selector means for receiving information therefrom identifying the individual channel selected and for displaying a character identifying the selected channel.

2.   The invention claimed in claim 1 wherein the character indicator means is a numeric display.

3.   The invention claimed in claim 1 wherein the selector means includes switch means constructed and arranged for stepping the selector means through each of the channels.

4.   The invention claimed in claim 1 wherein the switch means comprises a pair of switches constructed and arranged for stepping the selector means through the channels in opposite directions.

5.   The invention claimed in claim 1 wherein one
of the elements of the indicator means displays
Transmit Data status information for the selected
channel.

6.   The invention claimed in claim 1 wherein one
of the elements of the indicator means displays
Receive Data status information for the selected
channel.

7.   The invention claimed in claim 1 wherein one
of the elements of the indicator means displays
Request to Send status information for the selected
channel.

8.   The invention claimed in claim 1 wherein one
of the elements of the indicator means displays Clear
to Send status information for the selected channel.

9.   The invention claimed in claim 1 wherein one
of the elements of the indicator means displays Data
Set Ready status information for the selected channel.

10.   The invention claimed in claim 1 wherein one
of the elements of the indicator means displays Data
Carrier Detect status information for the selected
channel.

11.   The invention claimed in claim 1 wherein one
of the elements of the indicator means displays Data
Terminal Ready status information for the selected
channel.

12.   The invention claimed in claim 1 wherein one
of the elements of the indicator means displays Ring
Indicator status information for the selected channel.

13.   The invention claimed in claim 1 wherein the
monitor means determines whether output flow control
is active on the port and one of the elements of the
indicator means displays Output Flow Control Active
status information for the selected channel.

14.   The invention claimed in claim 1 wherein the
monitor means determines whether input flow control
is active on the port and one of the elements of the
indicator means displays Input Flow Control Active
status information for the selected channel.

15.   In a multi-channel communication device, an
integrated display means for showing the status of
each channel individually and for displaying system
information relating to operation of the device
itself, comprising, in combination:

    (a)   a plurality of indicator means mounted
           on the panel for providing ON-OFF
           indications in accordance with monitor
           means operatively coupled thereto;

    (b)   channel monitor means for monitoring
           the status of each channel in the
           device;

    (c)   system monitor means for monitoring the
           operation of the communication device;
           and

    (d)   controlled means for operatively
           coupling either the channel monitor
           means or the system monitor means to

the indicator means for displaying the status of a particular channel or for displaying system information.

16.   The invention claimed in claim 1 or claim 15, where the communication device is an asynchronous serial multi-channel communication device.

17.   The invention claimed in claim 15, wherein at least Transmit Data and Receive Data status signals are displayed on the indicator means.

18.   The invention claimed in claim 15, wherein Transmit and Receive Data status signals as displayed on the indicator means and wherein said controlled means is controlled by software, and wherein the indicator means is constructed and arranged for flickering to simulate the appearance of an indicator which is directly connected to the status signals.

19.   The invention claimed in claim 15, where the indicator means is constructed and arranged for display of at least one modem control signal selected from the group including RTS, CTS, DCD, DSR, DTR and RI.

20.   The invention claimed in claim 15, where the indicator means is constructed and arranged for display of all of the modem signals RTS, CTS, DCD, DSR, DTR and RI.

21.   The invention claimed in claim 15, where the indicator means is constructed and arranged for display of Input Flow Control active or Output Flow

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Control Active status signals.

22.   The invention claimed in claim 15, wherein the indicator means is constructed and arranged for display of all of the status signals described in claims 17, 18, 19 and 20.

23.   The invention claimed in claim 15, where the indicator means includes a character indicator which identifies the selected channel.

24.   The invention claimed in claim 15 wherein additional status functions are displayed on the indicator means.

25.   The invention claimed in claim 24, where the additional status functions displayed on the indicator means include a Processor Utilization signal showing the status of a serial line connecting the device to a host computer.

26.   The invention claimed in claim 24, where the additional status functions include a Line Utilization signal.

27.   The invention claimed in claim 24 where the additional functions include a communication line error indication.
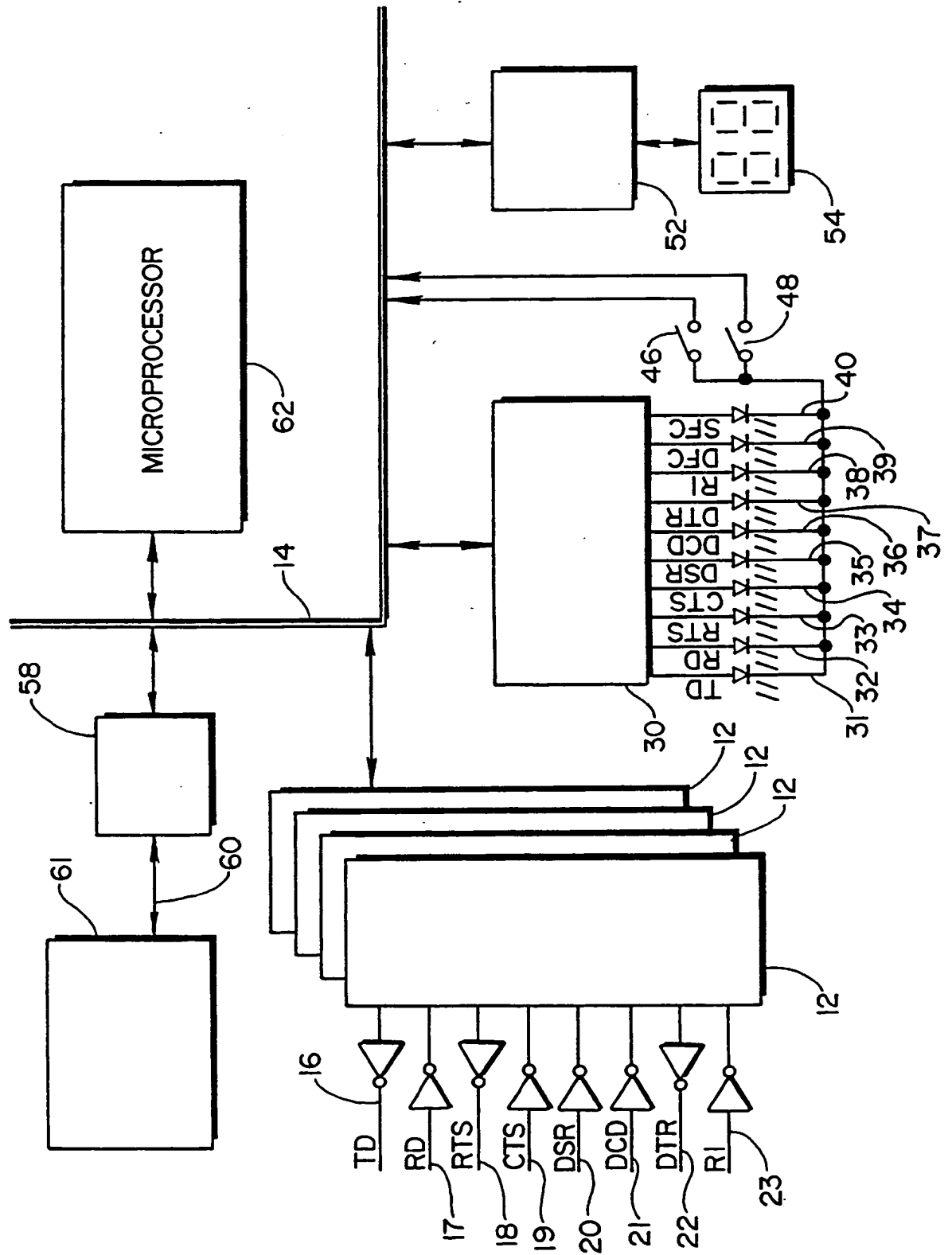
28.   The invention claimed in claim 24, wherein the indicator means includes a plurality of elements which provide ON-OFF indications as an activity display which has a repeating pattern to show that the device and the system of which it is a part are

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operational.

29.   The invention claimed in claim 28, where the
activity display updates at differing speeds to
indicate the level of system activity.

30.   The invention claimed in claim 24, wherein
the additional status functions displayed include a
communication line packet count.

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US92/01561

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 6

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC (5): H04B 1/38, H04L 5/00
U.S.Cl.: 340/825.A,753,815.02; 375/8

I FIELDS SEARCHED

Minimum Documentation Searched 7

Classification System	Classification Symbols
U.S.	340/825.16,825.17.815.02,915.03,753; 375/8,10

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched 8

III DOCUMENTS CONSIDERED TO BE RELEVANT 9

Category *	Citation of Document, 11 with indication, where appropriate, of the relevant passages 12	Relevant to Claim No. 13
X / Y	US, A, 4,646,320 (KRISHNAN) 24 February 1987 See col. 3, lines 25-30, figure 5, col. 10, lines 25-30	1-5,7-10,15-17 19,23-28,30 _____ 13,14,21,22
Y	US, A, 3,647,980 (FABIANO, JR. ET AL.0 07 MArch 1972 See col. 7, lines 9-22.	29 -
Y	US, A, 4,718,082 (PARKER ET AL.) 05 January 1988 See col. 6, lines 24-28.	6,11,12,18 20

* Special categories of cited documents: 10

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents. such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search

27 April 1992

Date of Mailing of this International Search Report

26 MAY

International Searching Authority

ISA/US

Signature of Authorized Officer.

Donald J. Yusko

Form PCT/ISA/210 (second sheet) (Rev.11-87)